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MANITOWOC, WIS.

ITS HARBOR LINES, CAR-FERRY, SLIPS AND DOCK FACILITIES.

REPORT

TO THE

MILWAUKEE & LAKE WINNEBAGO RAILROAD COMPANY,

SUBMITTED

DECEMBER 5, 1895

BY

HENRY L. ABBOT,

COLONEL CORPS OF ENGINEERS, UNITED STATES ARMY, RETIRED,

CONSULTING ENGINEER OF THE COMPANY.

[*With Plan of Harbor Lines adopted.*]

BOSTON:

ALFRED MUDGE & SON, PRINTERS,

No. 24 FRANKLIN STREET.

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MANITOWOC, WIS., ITS HARBOR LINES, CAR-FERRY, SLIPS AND DOCK FACILITIES.

MILWAUKEE, WISCONSIN, Dec. 5, 1895.

EDWIN H. ABBOT, Esq., *President*,
Milwaukee & Lake Winnebago R. R. Co.

Sir, — The connection of the city of Manitowoc with the Wisconsin Central system by the construction of the new branch between that city and Hilbert, and the establishment of car-ferry lines between it and Ludington by the Flint & Père Marquette Railroad, cannot but exert an important influence upon the traffic between the great grain-growing regions of the Northwest and the eastern seaboard, and before considering the harbor in detail the following general statement of facts will not be out of place.

COMMERCIAL ADVANTAGES OF MANITOWOC.

The port of Manitowoc is situated at nearly the middle point of the western shore of Lake Michigan, lying about one hundred and seventy miles from its most southern point and about one hundred and ninety miles from the straits of Mackinac, through which its waters mingle with those of Lake Huron. The city is distant only fifty-eight miles from Ludington, lying opposite on the eastern shore. About eight miles north of the straight line connecting these cities the width of the lake is contracted to about fifty miles by two projecting points, Big Point Sable extending three miles on the east and Rowley's Point extending seven miles on the west. The protection afforded by the latter has always rendered Manitowoc a favorite harbor of refuge in storms. Further to the southward the lake widens, the corresponding distance from Milwaukee to its nearest opposite port, Grand Haven, being eighty-five miles. This natural contraction has an important bearing upon winter navigation, as it tends to force the ice, drifting southward under the influence of

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the prevailing northerly winds, away from the two harbors of Manitowoc and Ludington, and thus to keep them unobstructed by floes when ports below are closed for long periods. Experience of many years has shown that this exemption can be depended upon during the entire winter, except perhaps for two or three days at a time while the wind holds unchanged in direction; and hence that this route across the lake is the best possible for the transfer of freight.

Its relations to the new through route projected between the East and the West have recently conferred important advantages upon Manitowoc. Together with Ludington it lies nearly on the direct air line between Minneapolis and Buffalo, a line that also passes close to the tunnel under the St. Clair at Port Huron, which has a capacity of 4,000 cars daily. These two ports are, therefore, on the shortest and best possible line for through traffic by rail. The reduction in distance over the shortest existing railway route between St. Paul and Buffalo, via Chicago, is material, amounting to 115 miles in 947 miles, or to about twelve per cent.

The establishment of the new car ferry between Manitowoc and Ludington will also do away with the cost and delay of transfers, which, with some classes of freight, is a matter of no small import. Once loaded on the cars at St. Paul or Minneapolis, the goods will go through to New York or Boston without further handling, as well as escaping the longer haul unavoidable on existing routes.

The same advantages will be extended by this new route to the region tributary to Duluth and Superior, and this will be of no little importance in the winter when Lake Superior is always closed by ice. Several lines of railway already existing will afford easy communication with Manitowoc and the new car ferry across Lake Michigan.

But quite independently of its relations to this through route, Manitowoc is destined to become one of the chief ports of Lake Michigan. It lies directly upon one of the main lines of the Chicago and North Western Railroad; and on the completion of the work now in progress it will become the lake terminal of the larger part of the Wisconsin Central system. The city thus has ample communication with the interior, and when its harbor is deepened to receive the great freighters now aiming to absorb the traffic of the

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lakes, it will be found to be adapted no less for general commerce than for the car-ferry trade. A shipper at Minneapolis or St. Paul giving preference to Manitowoc over Chicago will gain 92 miles of railroad haul and 300 miles of lake navigation, to say nothing of avoiding the cost and delay incident to switching and transfers in the over-crowded condition of the latter port (a loss estimated at nearly $4 per car). For Milwaukee, its only other rival, these figures are 7 miles of land and 150 miles of water haul. Thus while the local advantages at Manitowoc will prevent competition on equal terms by any other port on Lake Michigan, a great future is promised from its ability to offer cheaper rates and thus to relieve the congestion now severely felt at Chicago and Milwaukee.

Manitowoc is already a prosperous city of nearly 10,000 inhabitants. The locality is healthful, and well suited to become the seat of large manufacturing establishments. A good beginning has already been made, and with the improved facilities for communication now to be furnished a rapid extension may be expected.

Description of the Port.

Manitowoc harbor, like most of those on the Great Lakes, lies at the mouth of a small river which in freshets discharges a considerable volume of water charged to a moderate degree with sedimentary matter. No measurements have yet been made to determine the amount of water or earthy material thus contributed, but neither is large. Ordinarily the discharge is very small, the flow alternating in direction according to the relative level of the lake, and of the basin formed by the river bed.

Harbor Entrance. The General Government undertook the improvement of the harbor in 1852, and thus far has expended the sum of $356,040.50 in deepening the entrance. Two nearly parallel piers, 250 feet apart at the outer end and 220 feet at the shore end, have been extended into the lake. The northern pier is 1,970 feet long, and the southern pier 1,900 feet long. A breakwater of crib work 400 feet long was completed in 1895. It forms an angle of about forty-five degrees with the general direction of the piers, and lies about five hundred feet in advance of the northern pier.

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These structures have been repaired recently, and are in good condition.

The government survey of June, 1895, indicates between the piers a ruling depth of nearly eighteen feet, referred to the standard adopted as the mean level of the Great Lakes, which is 3.06 feet below the high water of 1838, the highest on record. All Engineer bulletins and surveys, including the Lake Survey Charts, are referred to this standard. The surface of Lake Michigan is subject to an annual oscillation of about a foot, being lowest in the winter and highest in the early summer. There is also a secular oscillation, often covering several years and amounting to two or three feet. During the current year (1895) the lowest level on record has been reached, the sequence of a gradual fall which, beginning in 1887, has continued from year to year with only a slight check in 1893 and 1894.

The annual mean this year will be about two feet below the standard, so that an available winter depth of about fifteen feet is all that can be counted on at present. It should be remembered, however, that the existing low level of the lakes affects the depth of the 20-21 foot channel as well, reducing it to not exceeding eighteen feet. Dredging between the piers to the extent of about three feet is therefore all that is required at Manitowoc to open the entrance to the new commerce; and the requirements at Ludington are the same.

The government work near the lake entrance has demonstrated that Manitowoc harbor is exceptionally free from the common tendency to deterioration from deposits between the piers and from the formation of a bar in front of them in the lake. That there is good reason for regarding this exemption as probable when the entrance is deepened to twenty feet, is indicated by the slow rate of advance of the shore line since the work of improvement was undertaken. On the south side of the piers this annual advance averaged only about eighteen feet during the eleven years from 1869 to 1880; and only about six feet during the thirteen years from 1880 to 1893. On the north side of the piers these figures are about six feet and five feet respectively. The shoaling at the lake end of the piers in the same thirteen years amounted to only about one foot. Few lake harbors have so favorable a record.

The Interior Harbor. Harbor lines, indicated upon the accom-

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panying map, have been projected for a distance of about 2.5 miles from the lake. Of the five miles of river bank included within this distance, about four are now occupied or are suitable for occupation as bulk-head landings for freight; and fully one of these four miles is well adapted to the construction of extensive slips, easy of railroad access and as capacious as the new docks at Manchester, England, provided to accommodate the new ship canal from the Mersey River. Moreover, if in the future larger demands should arise, the section of the river next above extending to the village of Manitowoc Falls will furnish the needful facilities for almost indefinite expansion. It is true that considerable dredging will be required; but as the demand will only be gradual, as commerce increases, the outlay will not be onerous, and whatever material is excavated will find useful application in raising the lower portions of the banks.

For about 3,000 feet adjacent to the lake, and in direct prolongation of the government piers, the river is straight and bordered by bulk-heads forming artificial banks. Two viaduct bridges afford the needed communication between the opposite sides of the harbor. Both are provided with the usual pattern of swing draws, with a central rest pier. The lower bridge has two openings each 59 feet in the clear. The upper bridge was designed to afford the same facilities for passage, but the northern opening, which alone is used by deep draft vessels, has only 57 feet at present, and the southern opening only 58.5 feet. It is an old structure, and when repaired by the city will be corrected in this respect.

The northern bulk-head between the lake and the lower bridge is occupied by the Goodrich Line of steamers and by warehouses; the southern bank in this vicinity is occupied by the Flint & Père Marquette steamers, warehouses, etc.

The only rock known to exist anywhere in the harbor is found in the shape of boulders between the two bridges. Those in the channel way are now under contract for removal by the city, which at its own expense is dredging from the government piers to the new car-ferry slip under construction by the Milwaukee and Lake Winnebago Railroad Company, including a turning ground above the upper viaduct bridge.

From the western end of the 3,000-foot straight channel the river

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extends northwestwardly for about 1,800 feet. The right bank is largely owned by the Chicago and North Western Railroad Company, and the left bank by the Milwaukee and Lake Winnebago Railroad Company. The new car-ferry slip of the latter company is now under construction just above the turn. The coal docks of the former company terminate this reach of the river.

At this western end the river makes an abrupt horseshoe bend northward, returning upon itself, so that the neck of the peninsula thus formed is only about 800 feet across, the distance around being 5,800 feet. This neck on the eastern side is occupied by the coal trestles, etc., above mentioned, and the dry dock and ship yard of the Burger & Burger Company; and on the western side by the railroads and a glue factory. The whole peninsula is low, and the larger portion is owned by the Improvement Company. It will afford an admirable site for a terminal car yard for the Milwaukee and Lake Winnebago Railroad, of which the station and warehouses will lie across the river.

On the left bank of this great bend, bluffs which are in places fully 75 feet high extend from the intersection of Chicago Street and Eleventh Street to Thirteenth Street, rendering this front unsuitable for docks; but above the latter street they recede, leaving a tract well suited for commercial occupation either by a single bulk-head 2,500 feet long, or by an extensive system of slips.

After making the horseshoe bend, the course of the river follows a northwesterly direction for 2,500 feet to the upper crossing of the new railroad, both banks being low and well adapted to commercial purposes. Above this crossing, as already stated, large water fronts are available whenever further space is needed in the harbor.

Within the limits under consideration, the only existing bridge, beside the two viaducts already described, is at the crossing of the North Western Railroad. This has no draw span, but one can easily be introduced. The city has in view the construction of two more viaducts, one on the prolongation of State Street, and the other to connect 19th Street with Spring Street above the North Western bridge. The new railroad will also require three crossings, one at the upper limit of the harbor as now projected, another below the glue factory, and a third above the dry dock. It is needless to suggest the im-

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portance of carefully considering the dimensions and location of the draw spans of any new bridge.

For the three bridges now under construction this matter has received the attention it deserves. At the upper crossing the axis of the bridge is necessarily oblique to the course of the stream, but lying as it does at the head of the harbor no draw span is needed at present. At the next crossing, near the glue factory, all requirements are met by a swing bridge of the usual type, with a centre rest pier and two clear openings each 61 feet in width. At the third crossing, near the dry dock, the natural conditions are unfavorable. The site lies in a bad bend, where much latitude for changing direction is indispensable to easy navigation. A single lift span adjacent to the left bank, with a clear opening of 69 feet, has been adopted. A substantial row of guide piles will be required on the eastern side, and perhaps a few on the western side, but the number of the latter should be restricted to an absolute minimum. These constructions, with the wide turning place artificially formed below, will meet all the needs of navigation.

The Projected Harbor Lines.

The dimensions, present and prospective, of the commercial marine of the Great Lakes should exert a controlling influence upon plans for new harbors, and this matter therefore first demands attention.

Lake Shipping. When the new lock at the Sault Ste Marie was projected, in connection with the 20–21 foot channel, the size of shipping to meet most economically the new conditions was carefully considered by Gen. O. M. Poe, Corps of Engineers, who had the matter in charge. After corresponding with the principal ship builders and owners, he reached the conclusion that the largest vessels would probably be about 350 feet long, with 46 feet beam; and the lock was planned accordingly. In anticipation of the early completion of these great works of internal improvement, a decided increase in size in vessels under construction soon became apparent; and before his death he had formed the opinion that a length of 450 feet with a beam of 50 feet and a registered tonnage ot 5,000 tons would be nearer the mark. I have been at some pains to collect the

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most recent authentic information as to this matter, and the results for vessels 300 feet in length and over are given in the following figures: —

Built in 1883:	number 1,	mean length 300 feet,	mean beam 36 feet.
1886	2	307	39
1887	1	301	39
1888	5	314	41
1889	3	309	40
1890	13	310	40
1891	5	312	41
1892	12	318	41
1893	8	343	43
1894	8	360	44
1895	13	394	45

The largest vessel for this trade thus far constructed was built in 1895 by the Globe Iron Works at Cleveland. Its length over all is 432 feet, its keel length is 412 feet, its beam moulded is 48 feet, its depth is 28 feet, its approximate net tonnage on 18 feet draft is 6,000 tons and on 19 feet draft 6,500 tons. It has triple expansion engines of 2,000 indicated horse power.

On the other hand, vessels of the whaleback pattern are developing on different lines. Captain Alexander McDougall, the inventor of this type and the general manager of the American Steel Barge Company, writes that there are now 35 of these vessels on the Great Lakes built by his company. About half of them are 262 feet long, with 36 feet beam and 22 feet depth of hold. These are designed for the enlarged Canadian canals. The other half are from 300 to 340 feet long, and are intended for general lake commerce. The smaller pattern costs only $42 per ton of carrying capacity. Of the larger class, a steamer 320 feet long and 42 feet beam has sufficient power to tow two similar consorts, when loaded, at a rate of eight miles per hour; and when without cargoes, at a rate of nine and a half miles per hour. On 14 feet draft the steamer carries 2,200 tons, and the consorts 2,500 tons each. Thus a steamer whaleback of this size towing two consorts makes the round trip from Duluth to Ashtabula in about twelve

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days, with a cargo of 7,200 tons. Captain McDougall is of the opinion that transportation by this method will be cheaper than by any other class of vessel. He has, however, now under construction four large ships of the whaleback type, one 404 feet long, two 380 feet long, and one 360 feet long, but does not expect better results than with the last steamer turned out, "which has to her credit the best record ever known, and she is only 320 feet long."

The new twin-screw steel car-ferry boat now under construction by the Flint and Père Marquette Railroad Company for use between Manitowoc and Ludington is 350 feet long, 56 feet beam, and has 19.5 feet depth of hull. It is designed to carry 30 cars on four tracks, and is covered over for protection in inclement weather. It will make two round trips daily, winter and summer. The speed in crossing the lake will be little if any below the average rate of through freight trains on land. In harbors a channel way at least 16 feet deep and 120 feet wide should be provided for her accommodation.

Such being the present condition of the carrying trade, a first-class harbor should be designed to accommodate easily vessels 350 feet long and 45 feet beam, and should be accessible to vessels 450 feet long with 50 feet beam. Good facilities for turning inside the harbor should be provided, as passage between the piers at the entrance is at best a delicate operation in the tempests which sometimes rage on the Lakes. The depth should conform to the requirements of the government 20-21 foot channel, whatever they may be. Upon this basis the harbor lines at Manitowoc have been laid down.

Map of the Harbor. The accompanying drawing, based on careful surveys, sets forth the harbor lines so clearly that little explanation is needful. Where vessels can lie on each bank a width of 250 feet has been adopted as the minimum, as this will afford a clear space of 150 feet for steamers using the channel. Where the natural conditions forbid vessels lying at both banks a minimum width of 200 feet will suffice, as this will preserve the full passage way.

Five turning places, conveniently spaced, are provided for vessels 350 feet long, and one of them will accommodate a vessel 450 feet long to the extent which probably will be required. The river is

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narrow and considerable bank cutting will be needful, but this is proposed only where the land is owned by the company, and hence no riparian rights are infringed. The material to be removed and dredged should be used to raise the level at low places on the banks, for it should not be forgotten that the present level of the lake is between five and six feet below the recorded high water of 1838, and over four feet below the level attained in 1859, 1861, 1876, 1883, 1885 and 1886. The contours on the map are referred to the zero of the government gauge on the harbor piers, which is 4.0 feet below the high water of 1838, and 0.94 feet below the standard adopted as the mean level of the Great Lakes.

It will be noted that straight bulk-head accommodation has been provided for six 350-foot vessels on the left bank adjacent to the city, where the needful warehouses, etc., will not interfere with the car-ferry slip or terminals. When more room is demanded, ample facilities exist further up stream, where slips or bulk-heads can be constructed as may be deemed most expedient under the conditions then existing.

In conclusion it may be said that in my judgment Manitowoc, fortunate in its geographical position and natural surroundings, with far-reaching railroad connections and good harbor facilities, only requires deep water and good plant for handling freight easily and rapidly, to become one of the great ports of the Lake region.

Very respectfully,

HENRY L. ABBOT,

Colonel Corps of Engineers, Retired,
Consulting Engineer.

NOTE. — Since the date of this report the harbor lines recommended have been approved and established by the Secretary of War, under date of Feb. 11, 1896.

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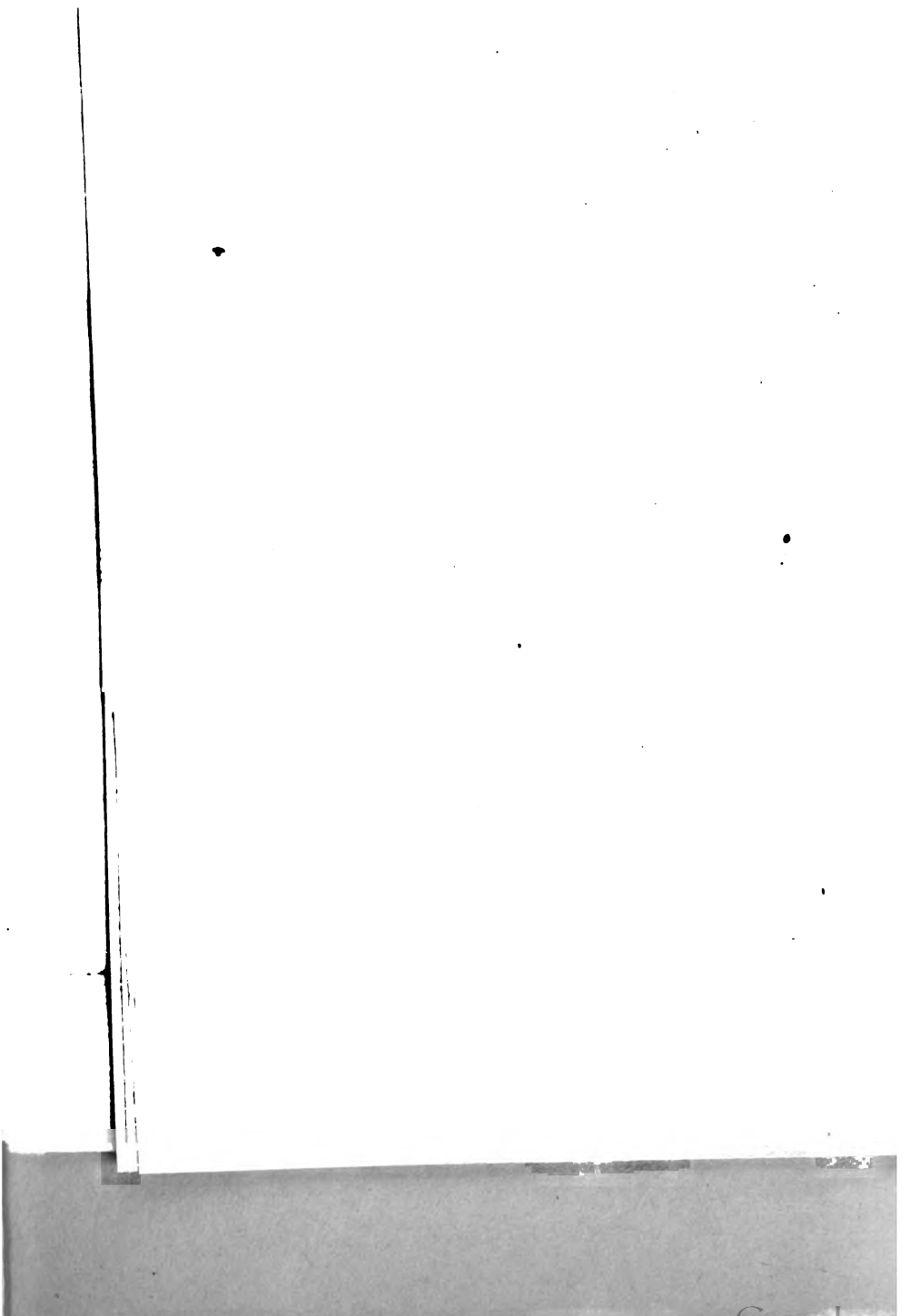

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